THE TOLLY GROUP

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3Com Corp.

3Com's® EtherLink® Server 10/100 PCI Network Interface Card with 3XP Processor versus Intel Corp.'s PRO/100 S

Competitive Evaluation of accelerated, aggregated, Fast Ethernet Server NICs in Windows 2000 and Windows NT 4.0 Environments

Test Summary

Premise: *Network managers deploying high-end servers with multiple LAN connections need to quantify the advanced performance aspects of those systems' network connections. It is not only important to know the aggregate system throughput achievable but the cost in system CPU resource to achieve it. Some of today's server NICs offer onboard processors that can offload work associated with data transmission from the server CPU. Such an approach offers the twin benefits of improving network throughput while freeing up server resource for application use.*

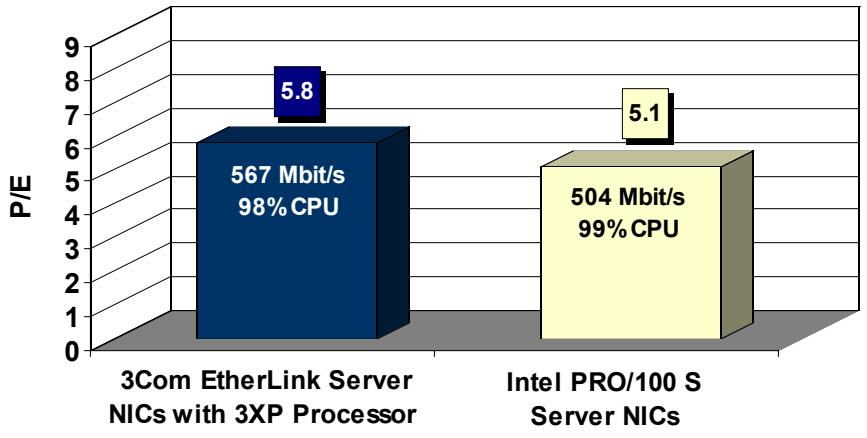
3Com Corp. commissioned The Tolly Group to evaluate its EtherLink Server 10/100 PCI with 3XP Processor, a Fast Ethernet server adapter outfitted with an onboard dedicated encryption co-processor, for throughput and CPU utilization in a variety of multi-adapter configurations in conjunction with an 800-MHz Compaq Corp. ML530 ProLiant dual-processor server running Microsoft Corp. Windows NT 4.0 or Windows 2000 Server. In addition, 3Com requested that The Tolly Group test Intel Corp.'s PRO/100 S Server Adapter, also a PCI-based Fast Ethernet server adapter, in the same set of tests. The Tolly Group quantified performance and CPU efficiency characteristics of these adapters in 4-adapter link aggregation configurations with and without IPSec

[1] The Ziff P/E index is a value computed from both the raw throughput of a network adapter and the cost in CPU resources necessary to achieve that throughput (see sidebar).

Test Highlights

- When IPSec tasks are offloaded from the Windows 2000 CPU to the hardware accelerators on the NICs, the four 3Com adapters achieve higher P/E scores than Intel's, whether in aggregated or non-aggregated configurations (P/E is 18% higher with aggregated links, 16% higher non-aggregated)
- The Windows 2000 P/E[1] index with four 3Com adapters exceeds the P/E index with four Intel adapters regardless of whether the 100Base-T links are aggregated or not
- Four 3Com adapters, in a non-aggregated Windows 2000 environment with unencrypted, bidirectional, file transfers, earns a P/E Index 14% higher than the P/E returned by four Intel PRO/100 S NICs
- When Windows 2000 aggregates the unencrypted Ethernet transfers, four 3XP cards deliver a 17% higher P/E index than four Intel PRO/100 S adapters, while Windows NT 4.0 (with aggregation) shows a 28% improvement with the 3Com NICs

Windows 2000 File Transfer Performance
(Comparison of four 3Com and Intel Fast Ethernet Adapters)



Four, non-aggregated, 100Base-T adapters, unencrypted 'Chariot' bidirectional file transfers

Source: The Tolly Group, May 2001 *Figure 1*

secure connections between clients and the server. Throughput and CPU consumption data were used, at 3Com's request, to calculate the Ziff-Davis "Performance/Efficiency" score. (See sidebar for details.) Testing was performed in January 2001.

The Ziff-Davis Performance/Efficiency Ratio

The Tolly Group tested and originally reported both the throughput results in Mbit/s and the percent of CPU utilization as discrete raw data. 3Com requested that The Tolly Group report the test results as calculated by the Performance/ Efficiency Index which was originally developed by Ziff-Davis' Labs and first published in PC Week (now eWeek) in 1995. The Ziff-Davis P/E ratio is calculated by dividing throughput (in Mbit/s) by CPU utilization (in percent). A higher Performance/ Efficiency ratio is better.

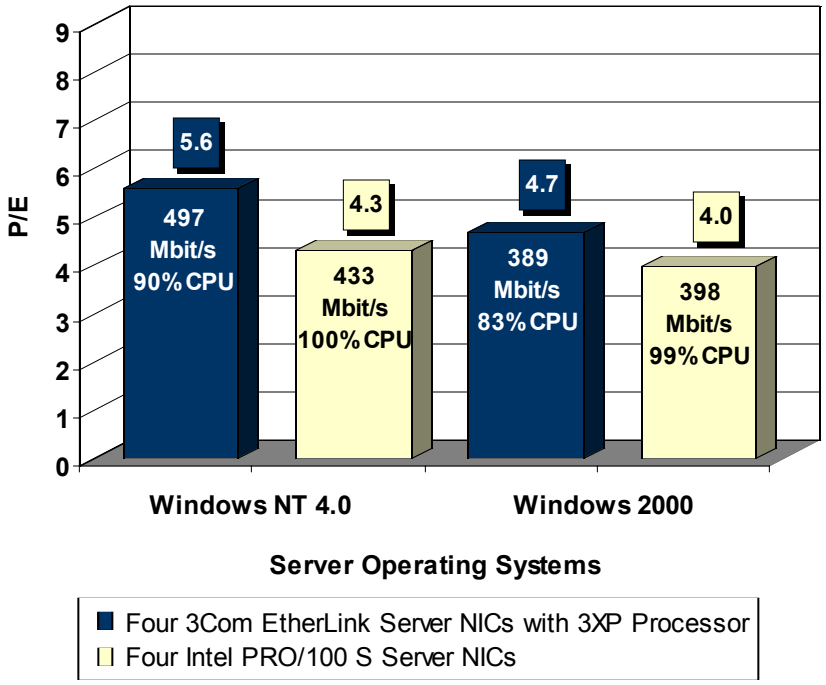
Results

Bidirectional File Transfer Performance with Four Non-aggregated Server Adapters: Windows 2000

The Tolly Group tested the bidirectional file transfer rate and CPU utilization of an 800-MHz Compaq ML530 ProLiant dual-processing server running under Microsoft Windows 2000, which was either equipped with four 3Com EtherLink server adapters or four Intel PRO/100 S server adapters. Results with the 3Com adapters demonstrate a throughput of 567 Mbit/s, and a CPU utilization of 98%, equivalent to a P/E index of 5.8. When equipped with the Intel PRO/100 S server adapters, throughput was 504 Mbit/s, and the CPU utilization 99%, resulting in a P/E index of 5.1. See figure 1.

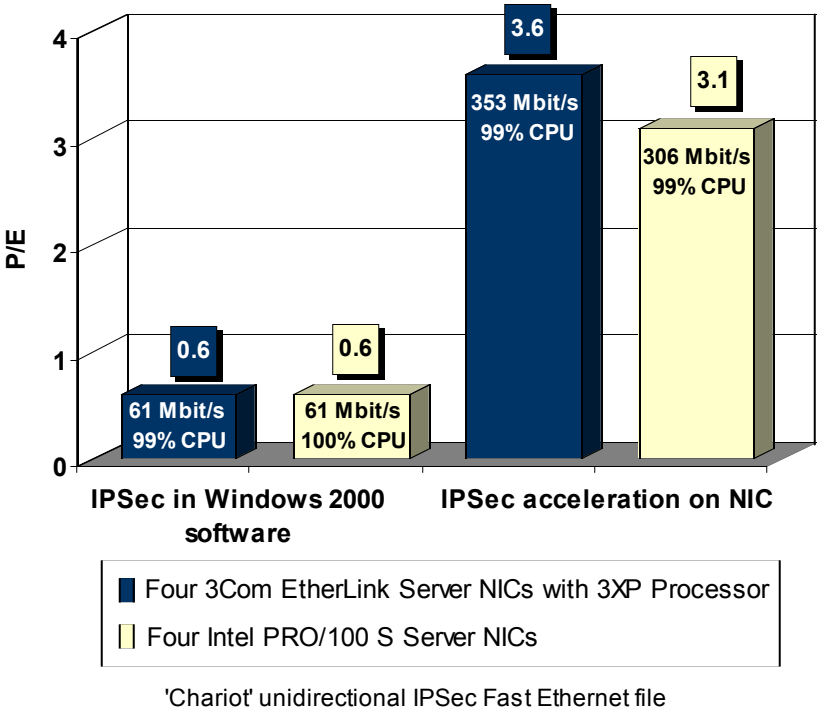
Bidirectional File Transfer Performance with Four Aggregated Server Adapters: Windows NT 4.0 and 2000

Tolly engineers also tested bidirectional file transfer rate and CPU utilization of



Ethernet adapters in 'aggregated' configuration, unencrypted 'Chariot' bidirectional file transfers

Source: The Tolly Group, May 2001 *Figure 2*



'Chariot' unidirectional IPSec Fast Ethernet file

Source: The Tolly Group, May 2001 *Figure 3*

the Compaq ML530 ProLiant server with four aggregated links in two separate operating environments. When using the Windows NT 4.0 operating system, and equipped with four linked 3Com EtherLink adapters, the server throughput was 497 Mbit/s with a CPU utilization of 90%, resulting in a P/E index of 5.6. With four aggregated Intel PRO/100 S adapters, throughput was 433 Mbit/s and the CPU utilization 100%, resulting in a P/E index of 4.3.

When Tolly engineers repeated this test in a Windows 2000 operating environment, results show that with four linked 3Com EtherLink adapters, the server throughput was 389 Mbit/s and the CPU utilization 83%, leading to a P/E index of 4.7. In the same test with four linked Intel PRO/100 S adapters, throughput was 398 Mbit/s and CPU utilization was 99%, resulting in a P/E index of 4.0. See figure 2.

Download File Transfer Performance with IPSec Enabled and IPSec Offload: Windows 2000

The Tolly Group measured the download server throughput and percent of CPU utilization of the Compaq server with IPSec enabled under Windows 2000 and four of each of the adapters under test, all of which were non-aggregated. Results show that in this scenario, with four non-aggregated 3Com EtherLink adapters, throughput was 61 Mbit/s and the percent of CPU utilization was 99%, resulting in a P/E of 0.6. In the same scenario with four non-aggregated Intel PRO/100 S adapters, throughput was also 61 Mbit/s and the percent of CPU utilization was 100%, resulting in a P/E of 0.6.

The Tolly Group then measured the download server throughput and percent of CPU utilization in tests where four non-aggregated adapters offloaded the server. With four 3Com EtherLink adapters, throughput was 353 Mbit/s with 99% CPU utilization. This results in a P/E index of 3.6. With four Intel PRO/100 S adapters, server throughput was 306 Mbit/s and CPU utilization was 99%. This results in a P/E index of 3.1. See figure 3.

Download File Transfer performance with Four Aggregated Links and IPSec Offload: Windows 2000

Tolly engineers conducted a final set of tests to measure the server throughput and percent of CPU utilization of the Compaq server with four aggregated links and IPSec offload. When equipped with four 3Com EtherLink adapters, results show server throughput at 301 Mbit/s with 92% CPU utilization. This results in a P/E index of 3.3. When engineers repeated the test with four Intel PRO/100 S server adapters, results show server throughput at 231 Mbit/s with 83% CPU utilization. This results in a P/E of 2.8. See figure 4.

Analysis

Adapter Acceleration Architecture

The primary function of a network adapter is to provide connectivity, in this case Fast Ethernet connectivity, between the server and other devices on the network. This 3Com adapter also contains a "3XP processor" capable of offloading both DES and 3DES encryption tasks from the server's CPU, freeing processor power for other tasks. The Intel adapter similarly features a co-processor which can offload DES and 3DES encryption. Both transfer data using standard 33-MHz PCI adapter slots, and both allow hardware offload of the SHA-1 and MD5 IPSec authentication algorithms.

3Com's 3XP accelerator is based on the ARM-9 RISC processor core. Intel has not disclosed on which core technology its I-82550EY co-processor is based.

Link Aggregation

Network administrators will be looking for Ethernet topologies which provide the highest possible throughput. As one would expect, those systems using multiple Fast Ethernet adapters were found to produce higher aggregate server throughput than those using a single Fast Ethernet adapter.

3Com Corp.

EtherLink 10/100 PCI with 3XP Processor

Competitive Evaluation

3Com Corp.
EtherLink 10/100 PCI with 3XP Processor
Product Specifications*

Features

- TCP/IP offloads reduce server CPU workload
- IPSec offloads include 168-bit 3DES, 56-bit DES, MD5, and SHA-1
- 3Com advanced server features deliver smart solutions to IT problems
- Install up to eight NICs for an aggregate throughput of 800 Mbit/s
- Self-healing drivers transparently monitor and repair active links
- Resilient server links add link redundancy and automatic failover
- Bidirectional load balancing works with any standards-compliant switch
- Support up to 16 virtual LANs from one server

Specifications

- Media: 10Base-T/100Base-TX
- Connector: RJ-45
- Bus: PCI Hot-Plug
- Data Path: 32-bit, 33-MHz
- Encryption: 3DES, DES, MD5, SHA-1
- Processor: ARM 9 RISC
- Operating distance (10Base-T): Category 3/4/5 UTP up to 100 m (328 ft)
- Operating distance (100Base-T): Category 5 UTP up to 100 m (328 ft)
- IEEE compliance: 802.3, 802.2, 802.1p, 802.1Q, 802.1 GMRP
- Standards compliance: PCI 2.1/2.2, DMI 2.0, WfM 1.0, ACPI 1.0, RWU
- Drivers: Linux, OpenServer, NetWare, UnixWare, Windows 2000/9x/NT
- Management: Any SNMP management platform, including 3Com® Transcend® Network Supervisor

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**Vendor-supplied information not verified by The Tolly Group*

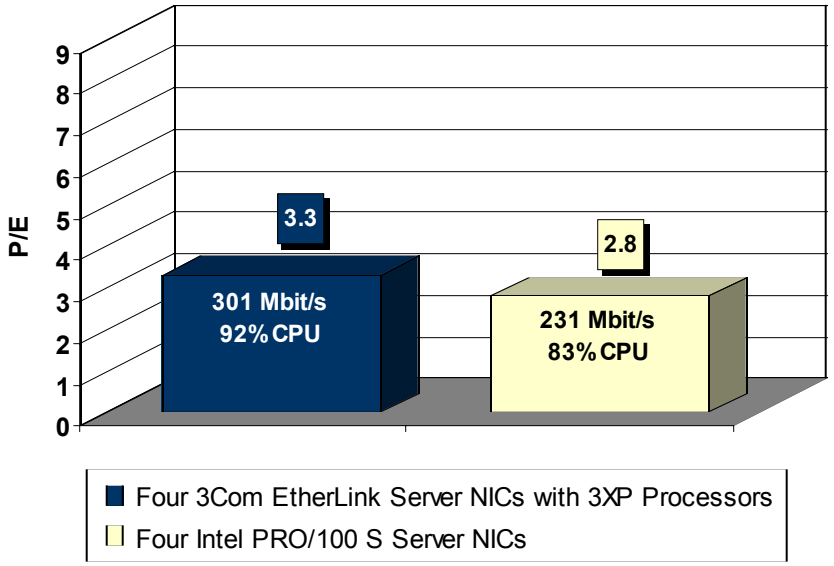
The high availability and relative low cost of Fast Ethernet adapters has made them a popular item in many existing network environments. The introduction of link aggregation now offers network administrators an inexpensive migration path to more effective resource management. Using link aggregation across multiple adapters allows today's network managers to increase the available network bandwidth from high-performance servers, without increasing infrastructure floor space requirements or incurring significant upgrade costs. Link aggregation effectively interleaves traffic from multiple adapters, improving overall system throughput by increasing the number of physical links between the server and other networked computers. When link aggregation is enabled, multiple adapters physically mounted in a single server appear to act as one adapter.

Link reliability is increased, as the impact of a single card failure will only cause performance degradation, and not the failure of the entire network. In servers equipped with only one adapter, a failure of that link will cause the entire network connectivity to be lost.

In our testing, both the 3Com EtherLink and the Intel PRO/100 S server adapters come with software drivers that enable a pair of adapters to function as one "virtual" adapter.

Our testing of these Fast Ethernet adapters with link aggregation distributed amongst four server adapters produced some unexpected results. Under Windows 2000, non link-aggregated adapters (both 3Com and Intel) produced higher throughput than when link aggregation was enabled. One explanation for this could be that the increased overhead in running the system software necessary to enable link aggregation results in lower throughput. Link aggregation is still desirable to those network administrators who need its link resiliency/fail-safe capabilities, or who lack network address space.

Windows 2000 File Transfer Performance with IPSec
(Four Aggregated Adapters with Accelerated IPSec)



Four aggregated adapters, IPSec hardware acceleration on NICs, 'Chariot' unidirectional Fast Ethernet file transfers

Source: The Tolly Group, May 2001 *Figure 4*

Link aggregation tests using four server adapters running under Windows NT produced higher throughput than similar tests running under Windows 2000 regardless of whether the Intel and 3Com adapters were used. One possible explanation may be the relative maturity of the Windows NT drivers and software compared with that of the Windows 2000 software.

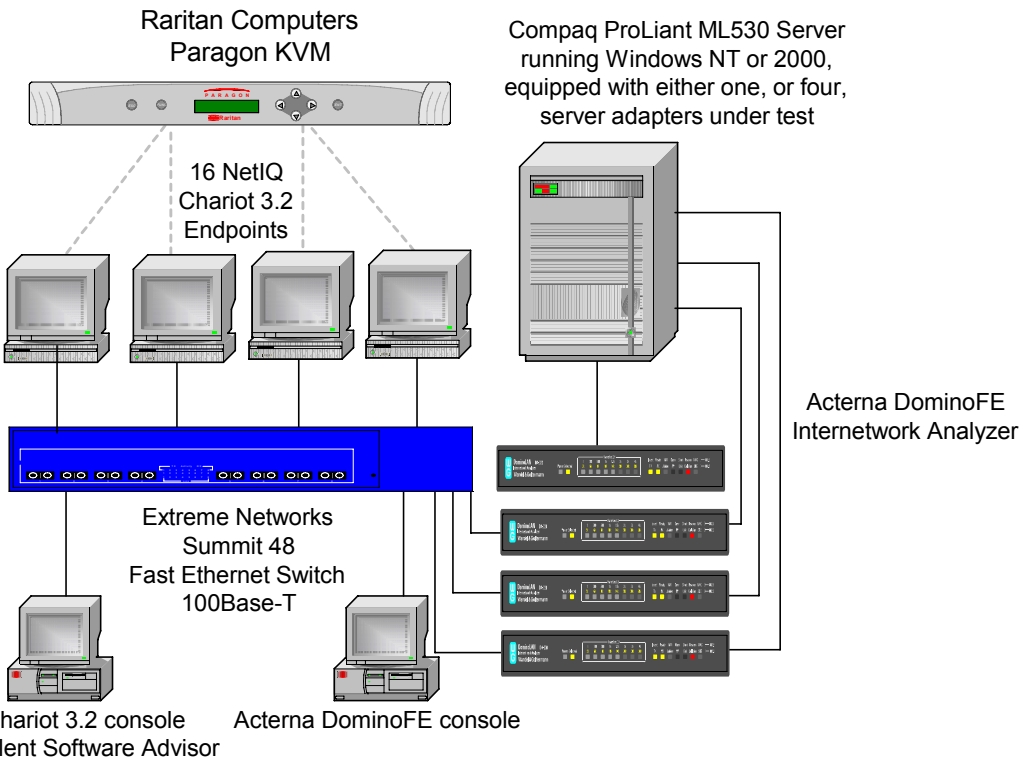
IPSec Security

With the proliferation of network security breaches, encryption of network traffic has become increasingly necessary. When running a Windows 2000 network, IPSec is a logical choice to implement network security since it can be easily configured in the network with both clients and servers. The new generation of network adapters includes on board network processors, which will increase throughput and decrease server load through performing the encryption/decryption process by offloading this process from the server CPU load. Both the 3Com EtherLink and the Intel PRO/100 S server adapters come equipped with on board IPSec offload capabilities.

Industry studies have shown that running network adapters capable of offloading IPSec encryption/ decryption processing from the server to the adapter can increase network performance from five to ten times in output compared to letting the server handle the encryption/decryption process. This was demonstrated with the testing of the 3Com with its 3XP processor handling the offload processing. The 3Com adapter provided higher throughput in both upload and download processing when offloading to its on-board processor as compared to the similarly equipped Intel adapter when the server was equipped with four adapters running simultaneously.

It is important to note that in the current tests only the bidirectional flow scenarios were conducted in a logically full-duplex switched environment. The download flow tests were logically half duplex. That is, the

Test Bed



Source: The Tolly Group, May 2001

Figure 5

primary traffic flow for download scenario was overwhelmingly unidirectional, with a theoretical maximum throughput of 400 Mbit/s for the test with four server adapters. Thus, it is appropriate to view the "theoretical maximum" throughput for a bidirectional flow scenario to be 800 Mbit/s. In the download scenario, it would be correct to view the "theoretical maximum" as 400 Mbit/s.

Test Configuration and Methodology

For this test, Tolly Group engineers used a Compaq Corp. ML530 ProLiant Server, with dual 800-MHz Pentium III Xeon processors with 640 Mbytes of RAM. This server was running either Microsoft Corp. Windows NT 4.0 Service Pack 5, or Microsoft Windows 2000 Advanced Server with Service Pack 1. The server was equipped with four of the NICs under test.

3Com Corp. supplied four EtherLink 10/100 33-MHz PCI Server Adapters for our testing. All had 3XP Processors, and all were model number 3CR990SVR97 with driver version el99xnd5.sys 1.01.21.0000 for Windows 2000 and driver version el99xnd4.sys 1.01.21 for Windows NT.

The Intel adapters under test were all Intel PRO/100 S Server Adapters, all were PCI bus card model number 832702, with driver version e100bnt5.sys 5.0.67.0000 for Windows 2000 and driver version e100bnt.sys 5.00.66.0000 for Windows NT.

The server connected to 16 clients running NetIQ Chariot 3.2 Endpoint software via an Extreme Networks Summit48 Fast Ethernet switch. The following devices ran the Chariot Endpoint software: 550-MHz dual processor Pentium III Xeon Compaq ProLiant 6400R with 256 Mbytes of RAM and 9.1 Gbytes of fixed-disk space; a 450-MHz Pentium II Xeon Compaq ProLiant 5500 with 256 Mbytes of RAM and 4.3 Gbytes of fixed-disk space; and 14, 550-MHz Pentium III generic PCs with 128 Mbytes of RAM and fixed-disk space of 18 Gbytes. All 16 devices were equipped with a 3Com EtherLink 10/100 Mbit/s 3CR990-TX-97, 33-MHz adapter, driver version EL99XND4.sys 1.01.21.0000. All clients ran Microsoft Windows 2000 Professional, Service Pack 1 High Encryption.

A 200-MHz Intel Corp. Pentium with 64 Mbytes of RAM, a fixed-disk space of 628 Mbytes, with both ISA and PCI bus cards served as the Chariot console. The device was also equipped with a 3Com EtherLink 10/100 Mbit/s 3CR990-TX-97 PCI adapter driver version EL99XND4.sys 1.01.21.000, and was running Windows NT 4.0 Service Pack 5.

An Acterna Corp. DominoFastEthernet Internetwork Analyzer sat in-line with the Compaq server and the Extreme switch. A 400-MHz Authentic AMD with 64 Mbytes of RAM, both ISA and PCI bus cards, and 2.1 Gbytes of fixed-disk space, served as the Domino console. The console was equipped with a 3Com Corp. EtherLink 10/100 Mbit/s 3CR990-TX-97 PCI adapter, driver version EL99XND4.sys 1.01.21.0000, and was running

Microsoft Windows NT Workstation 4.0 Service Pack 5. See figure 5.

In order to test the baseline, Tolly engineers used Chariot to send "file send long" (filesndl.scp) and "file receive long" (filercvl.scp), bidirectional TCP/IP traffic and measured the aggregate server throughput and percent of server CPU utilization.

To test the server performance with link aggregation, Tolly engineers used four link aggregated server cards under test and sixteen client cards. Bidirectional TCP/IP traffic was initiated by Chariot in file send long (filesndl.scp) and file receive long (filercvl.scp) scripts and results were measured for two minutes for three iterations, as reported by Chariot.

In order to test the server performance with IPSec offload, Tolly engineers used the Windows 2000 High Encryption Pack on the server for 3DES support. Engineers configured IPSec with the following specifications: ESP authentication; 3DES encryption; and SHA-1 encryption algorithm with a pre-shared secret key. Tolly engineers used Chariot to send file send long (filesndl.scp) and file receive long (filercvl.scp), bidirectional TCP/IP traffic and measured the aggregate server throughput and percent of server CPU utilization, as reported by Chariot. Engineers repeated this test with link aggregation and measured the server throughput and CPU as reported by Chariot with link aggregation and IPSec offload combined.

The DominoFE Internetwork Analyzer was used to capture and monitor traffic for all tests.

Equipment Acquisition and Support

The Intel Corp. PRO/100 S Server Adapters used in this test were acquired through normal product distribution channels. The Tolly Group contacted executives at Intel and invited them to provide a higher level of support than available through normal channels. Intel accepted The Tolly Group's offer. Intel phone technical support was used to configure/tune the device for the test suites executed by The Tolly Group.

The Tolly Group verified product release levels and shared test configurations with Intel in order to give executives an opportunity to optimize their devices for the tests. Results were shared with Intel whose representatives acknowledged their accuracy. For a more complete understanding of the interaction between The Tolly Group and Intel, check out the Technical Support Diary for Competitive Products Tested posted on The Tolly Group's World Wide Web site at http://www.tolly.com (see document 201105).

The Tolly Group gratefully acknowledges the providers of test equipment used in this project.

Vendor	Product	Web address
Acterna Corp.	DominoFastEthernet	http://www.acterna.com
NetIQ	Chariot 3.2	http://www.netiq.com
Raritan Computer, Inc.	Paragon KVM	http://www.raritan.com

Since its inception, The Tolly Group has produced high-quality tests that meet three overarching criteria: All tests are objective, fully documented and repeatable.

We endeavor to provide complete disclosure of information concerning individual product tests, and multiparty competitive product evaluations.

As an independent organization, The Tolly Group does not accept retainer contracts from vendors, nor does it endorse products or suppliers. This open and honest environment assures vendors they are treated fairly, and with the necessary care to guarantee all parties that the results of these tests are accurate and valid. The Tolly Group has codified this into the Fair Testing Charter, which may be viewed at http://www.tolly.com.

Project Profile

Sponsor: 3Com Corp.

Document number: 201105

Product Class: Fast Ethernet server adapters

Products under test:

- 3Com Corp. EtherLink 10/100 PCI with 3XP Processor
- Intel Corp. PRO/100 S Server Adapter

Testing window: January 2001

Additional information available:

- Technical Support Diary

For more information on this document, or other services offered by The Tolly Group, visit our World Wide Web site at http://www.tolly.com, send E-mail to info@tolly.com, call (800) 933-1699 or (732) 528-3300.

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